

Sensory Attributes, Nutritional Composition and Microbial Load of Value Added Bakery Product “Muffins” Prepared by Incorporation of Black Rice Flour and Flax Seed Flour

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Abstract:

Black Rice Flour and Flax Seed Flour are incorporated into “Muffins” to improve their nutritional value and sensory qualities. They are consequently a delicious and healthy option among consumers looking for more nutritious snacks. Commercially available “Muffins” are prepared from refined flour that is nutritionally inferior in the quality. The desired outcome of the present study was assessed the sensory attributes of value-added bakery product “Muffins” prepared by incorporation of Black Rice Flour and Flax Seed Flour, nutritional analysis and microbial load of value added “Muffins” done by AOAC method. The statistical analysis of value added “Muffins” by variance (ANOVA), (C.D) techniques, “t-test” and cost estimation. Standard recipe “Muffins” served as a control (T₀) with three treatment combinations, were prepared by replacing Refined Flour with different ratio of Black Rice Flour and Flax Seed Flour which were referred as T₁, 25:45:30gm T₂, 30:50:20gm and T₃ 35:55:10 gm respectively. value added “Muffins” are distinguished by the crumbly, moist structure and improved organoleptic characteristics. They were analyzed on Nine Point Hedonic Scale score card for different Sensory Attributes. The result revealed that T₂ (9) was found to be the most acceptable regards to its overall proportion followed by T₁(7.2), T₀ (6.9) and T₃ (7.0) were liked moderately by the Sensory Panel Members respectively. Nutrient content was significantly increased in Best Treatment T₂ as compared to control (T₀) and Microbial load i.e., Total Plate Count, Yeast and Mould count and Coliform count was found safe to consume till 7 days. So, it was concluded from the result that the value addition of Black Rice Flour and Flax Seed Flour at different level, can improve the sensory attributes, nutrient content and microbial load of enriched “Muffins” Through this, the costs are decreased while remaining acceptable and reasonable in comparison to the marketplace price.

Keywords: Sensory Qualities, Nine Point Hedonic Scale, baked product, Black Rice Flour and Flax Seed Flour.

INTRODUCTION

The usual consumption of bakery products presents certain drawbacks related to their high content of simple sugars of rapid absorption, high fat content and low amount of dietary fibre, which make them highly caloric foods. Bakery products like muffins, contain refined flour as primary ingredient as it contributes to structure and volume but it is nutritionally inferior in the quality. By incorporation of Black Rice Flour and Flax Seeds Flour in bakery goods is to increase the availability of nutrients in value added food Products, Black Rice is rich in anthocyanin and Flax Seeds are rich in flavonoid which are good water-soluble antioxidants. They are easily absorbed in the body and helps in removal of harmful free radicals. They prevent damage from oxidative stress which may cause aging or degenerative diseases like Alzheimer's, cancer and diabetes. Black Rice and Flax Seed is considered good for kidney, stomach and liver. This can be attributed to possible antioxidant property. **Kaur et al., (2018)** Muffins are a type of semi- sweet cake quick bread that is baked in appropriate portion. They are similar to cupcakes, Incorporated flaxseed into Muffins as 28.5 percent of the total Recipe and compared their oxidative stability to Control Muffins with no Flaxseeds. After Baking for two hours at (178⁰C) there were no changes in the alpha-linolenic acid, although oxygen consumption was greater for the Flax Seed Muffins. The wide consumption of bakery products makes them ideally suited for fortification as foods for the daily consumption. Flaxseed can be added to baked products as a whole seed, imparting a healthy appearance and increased texture and flavour of quality and black rice is rich in Anthocyanin Pigment which are good water soluble antioxidants, which easily absorbed in our body and helps in removal of harmful free radicals for body. They prevent damage for oxidative stress of free radicals which may cause aging or degenerative diseases like Alzheimer's, cancer and diabetes. **Chutipaijit et al.,(2011).**

OBJECTIVE OF THE STUDY

Keeping in view the following study aimed to assessed the sensory attributes of value-added bakery product “*Muffins*” Prepared by incorporation of Black Rice Flour and Flax Seed Flour, Nutritional Analysis, Microbial Load and Cost estimation.

MATERIALS AND METHODS

The Present Study was conducted in the Nutrition Research Laboratory, Department of Food Nutrition and Public Health, Ethelind College of Home Science, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj.

PROCUREMENT OF RAW MATERIALS

The raw materials, Chakhao Forbidden Manipur Black Rice was purchased online from Amazon shopping website. Flax Seeds (Frutin's), (Tata I Shakti) Food Grade Cooking Soda, (Weikfield) Baking Powder, loose sugar (Tata Salt Vacuum Evaporated Iodised) Salt, these raw materials required for the preparation of value-added bakery product "*Muffins*", were purchased from the local market of Prayagraj (U.P.).

PROCESSING OF RAW MATERIALS

The standard procedure was slightly modified for the preparation of Black Rice Flour and Flax Seed Flour.

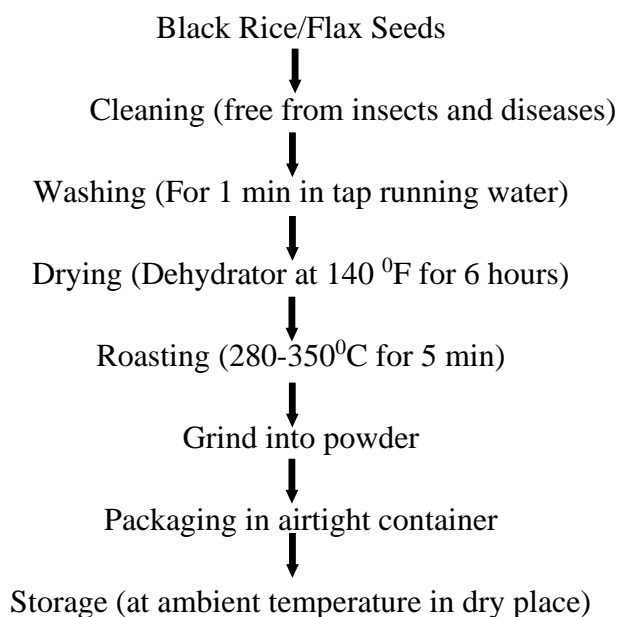


Fig no: 1 Preparation of Black Rice Flour/Flax Seed flour

Source: http://megagriculture.gov.in/public/black_rice_processing/extraction.aspx

PRODUCT FORMULATION

Value added Bakery based product such as “*Muffins*” was prepared by incorporation of 30 grams Refined Flour, 10 grams Flax Seed Flour and 55 grams Black Rice Flour, the experiment was prepared and replicated 3 times to get an average value, the control (T_0) was prepared with 100 percent Refined Flour. Preheat oven at 120°C for 10 minutes. Weigh all the ingredients. Take 30 gm butter and 30 gm sugar and 5 ml vanilla essence mix it in bowl. In another bowl take Black Rice Flour, Flax Seed Flour, Refined Flour sieve it Properly, add 2 gm baking powder and 2 gm salt together. Add 50 ml milk and beat it until it becomes smooth thicken batter and transfer into the muffin mould, bake in pre-heated oven at 120°C for 20-25 minutes for uniform baking. Store and use within 7 days at room temperature.

STATISTICAL ANALYSIS

The data was statistically analysed by using of two way Anova and significant difference between the treatments was determined by using CD (Critical Difference), test ‘t-test’, **Gacula, Jr. and Singh (2008)**

ORGANOLEPTIC EVALUATION

During preliminary trials, prepared value added “*Muffins*” were evaluated for sensory characteristics, based on Nine Point Hedonic Scale for colour, taste, texture, flavour and overall acceptability by 5 Sensory Panel members. The scores were based on the following criteria: Like extremely: 9; Like moderately: 7-8; like slightly: 5-6; dislike slightly: 3-4; and dislike extremely: 0-2. (**Srilakshmi B. 2007**)



Plate 1: Panel Members for Sensory Evaluation

RESULT AND DISCUSSION

Table 1: Sensory acceptability scores of “Muffins” prepared by using Black Rice Flour and Flax Seeds Flour.

Control and Treatments	Colour and Appearance	Body and Texture	Taste and Flavour	Overall Acceptability
T₀ Mean ± SE	6.9±0.05	6.8±0.09	6.92±0.06	6.8±0.05
T₁ Mean ± SE	7.2±0.09	7.3±0.35	6.83±0.13	6.8±0.10
T₂ Mean ± SE	9±0	8.9±0.00	8.98±0.01	9±0
T₃ Mean ± SE	7.0±0.00	7.6±0.24	6.6±0.19	6.9±0.05
F_{Cal} (5%)	150.2	16.4	100.0	273.7
F_{Tab} (5%)	4.76	4.76	4.76	4.76
CD(P≤0.05)	0.357	1.083	0.502	0.294
S.A.	S*	S*	S*	S*

S=Significant, NS**=Non-Significant, S.A. **=Statistical Analysis (P≤0.05)*

The above table no: 1 show that the average Sensory Score of Value- added “Muffins” on the basis of all parameters like Colour and Appearance, Body and Texture, Taste and Flavour and Overall Acceptability.

The result was evaluated for sensory characteristics, based on Nine Point Hedonic Scale for colour and appearance, taste and flavour, body and texture and overall acceptability by 5 Sensory Panel members. T₂ had the highest Colour and Appearance score (9) followed by T₁ (7.2), T₀ (6.9), and T₃ (7.0). Due to its golden brown colour, which ascribed it more acceptable and delicious by the 5 sensory panel members due to balance proportion of Refined Flour 30 gm+ Black Rice Flour 50 gm + Flax Seed Flour 20 gm. Body and Texture indicates that T₂ had the highest score (8.9) followed by T₀ (6.8), T₁ (7.3) and T₃ (7.6), which provided crunchy, crispy and moist texture when sensory panel member cracked at the time of testing, which was found most acceptable and delicious by the 5 sensory panel members due to balance proportion

of Refined Flour 30 gm+ Black Rice Flour 50 gm + Flax Seed Flour 20 gm. Taste and Flavour indicates that T₂ had the highest score (8.98) followed by T₀ (6.92), T₁ (6.83) and T₃ (6.6), which seems slightly nutty and little bitter, crunchy and buttery flavour in mouthfeel which was more acceptable by sensory panel member due to balance proportion of Refined Flour 30 gm+ Black Rice Flour 50 gm + Flax Seed Flour 20 gm. Sensory Score of overall acceptability indicates that T₂ had highest Overall Acceptability in Colour and Appearance due to its golden brown colour, Body and Texture which provided crunchy, crispy and moist texture, Taste and Flavour provided slightly nutty and little bit bitter flavour, which ascribed it more acceptable and delicious in the ratio of Refined Flour 30gm + Black Rice Flour 50 gm + Flax Seed Flour 20 gm by the Sensory Panel Members. The sensory score of overall acceptability of value added “Muffins” T₂ had the highest score (9) followed by T₀ (6.8), T₁ (6.8) and T₃ (6.9), respectively. The amount of the best treatment T₂ had 30 percent Refined Flour+50 percent Black Rice Flour+20 percent Flax Seed Flour.

The statistical analysis carried out on different sensory parameters have shown that the calculated value of ‘F’ on 4 and 8 degree of freedom at 5% probability level, so it was found significant difference between control and treatments, regarding all sensory attributes such as Colour and Appearance, Body and Texture, Taste and Flavour and Overall Acceptability of the value added “Muffins”. In relation to Colour and Appearance of calculated value “F” (150.2) due to treatments was higher than tabulated value of F (4.76). Therefore it indicated that there was significant difference in Colour and Appearance between the three treatments of “Muffins” It compared against Critical Difference in the mean value of (T₁, T₀), (T₂, T₀), (T₂, T₁), (T₃,T₀) (T₃,T₂) was greater than CD (0.357), therefore the difference was significant.

In relation to Body and Texture of calculated value “F” (16.4) due to treatments was higher than tabulated value of F (4.76). Therefore, it indicated that there was significant difference in Taste and Flavour between the three treatments of “Muffins” It compared against Critical Difference in the mean value of (T₁, T₀), (T₂, T₀), (T₂, T₁), (T₃,T₀) (T₃,T₂) was greater than CD (1.083), therefore the difference was significant.

In relation to Taste and Flavour of calculated value “F” (100.0) due to treatments was higher than tabulated value of F (4.76). Therefore, it indicated that there was significant difference in Taste and Flavour between the three treatments of “Muffins” It compared against Critical

Difference in the mean value of (T₁, T₀), (T₂, T₀), (T₂, T₁), (T₃,T₀) (T₃,T₂) was greater than CD (0.502), therefore the difference was significant.

In relation to Overall Acceptability calculated value of “F” (273.7) due to treatments was higher than tabulated value of F (4.76) Therefore, it indicated that there was significant difference in Overall Acceptability between the three treatments of “Muffins” It compared against Critical Difference in the mean value of (T₁, T₀), (T₂, T₀), (T₂, T₁), (T₃,T₀) (T₃,T₂) was greater than CD (0.294) therefore, the difference was significant. It can be concluded that the average score for all parameters of sensory attributes of value added “Muffins” differ significantly, which may be ascribed to different ratio of 30 percent Refined Flour+50 percent Black Rice Flour+20 percent Flax Seed Flour in value added “Muffins”

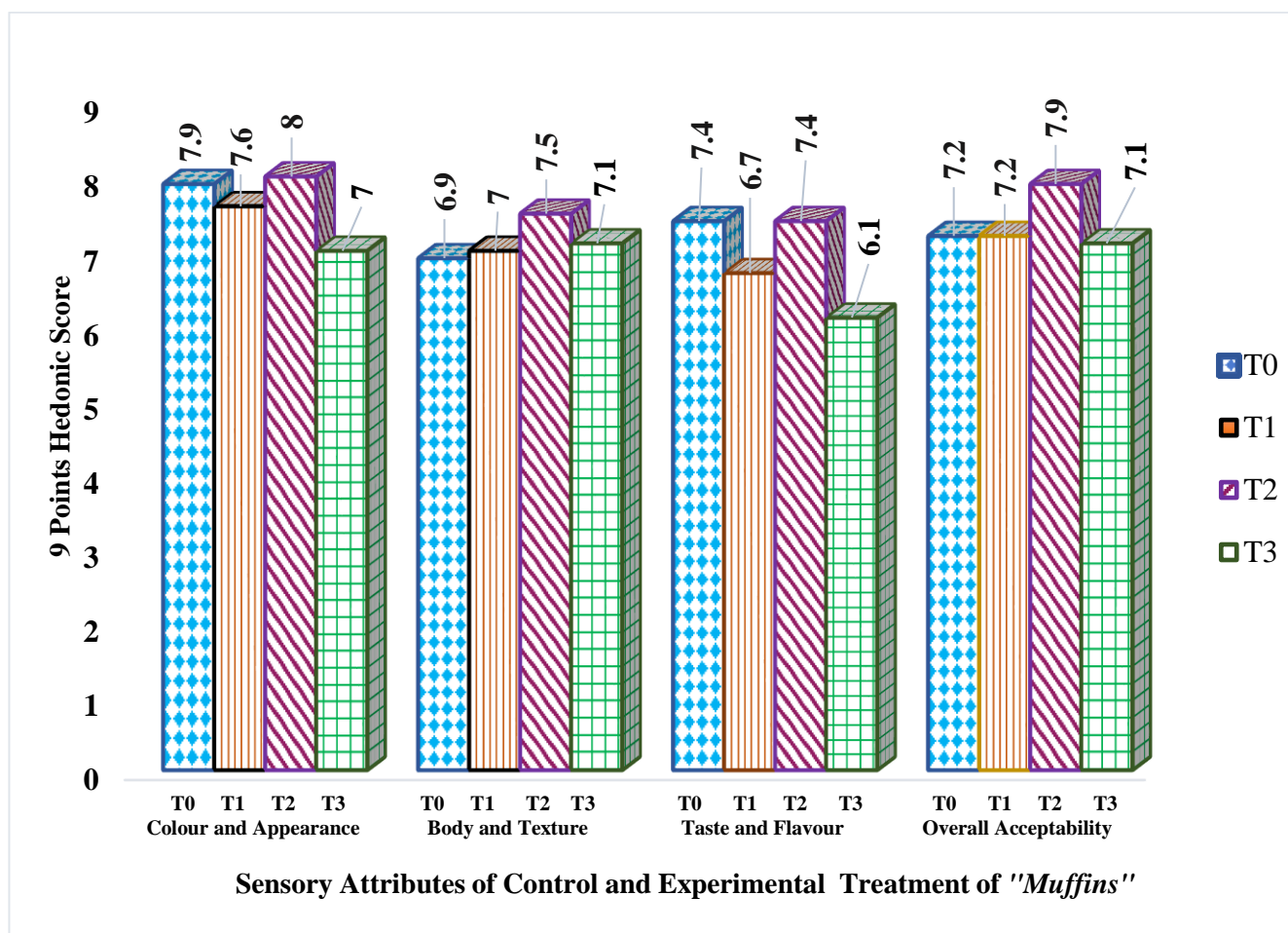


Fig no:2 Average Sensory scores of Control and Experimental Treatment of value added “Muffins”

Table: 2 Comparative analysis of Proximate content, Mineral Content, Anti-Nutritional Factor and Anti-Oxidant content/100gm of Control (T₀) with Best treatment (T₂) of “Muffins” by using “t-test”.

Nutrient Content	T ₀ (Control)	T ₂ (Best Treatment)	(Difference) (T ₀ -T ₂)	't'cal.	't'tab. (5%)	S.A. (P<0.05)
Proximate Analysis						
Moisture (%)	28.85±0.01	17.97±0.01	10.88	1332.52	2.44	S*
Ash (g)	2.14±0.01	4.46±0.01	2.32	7.01	2.44	S*
Protein (g)	3.21±0.01	12.84±0.01	9.63	1444.0	2.44	S*
Fat (g)	10.68±0.01	11.17±0.01	0.69	66.63	2.44	S*
Crude Fibre (g)	1.13±0.01	4.87±0.01	3.74	561.5	2.44	S*
Carbohydrate(g)	56.33±0.01	49.97±0.01	6.36	720.77	2.44	S*
Energy (Kcal)	346.68±0.01	400.47±0.01	53.79	8068.0	2.44	S*
Mineral Content						
Iron (mg)	1.82±0.01	2.82±0.01	1	122.47	2.44	S*
Calcium (mg)	21.47±0.01	65.43±0.51	43.96	3296.75	2.44	S*
Zinc(mg)	0.78±0.01	1.65±0.02	0.87	46.69	2.44	S*
Phosphorous(mg)	68.23±0.01	166.08±0.01	97.85	9282.54	2.44	S*
Potassium(mg)	74.14±0.01	245.28±0.01	171.14	13256.44	2.44	S*
Anti-Nutritional Factor						
Oxalate(mg)	0.07±0.01	0.17±0.08	0.1	1.66657	2.44	NS**
Tannin(mg)	0.70±0.21	1.52±0.31	0.82	2.74886	2.44	NS**
Phytate (mg)	0.44±0.17	0.74±0.16	0.3	1.65949	2.44	NS**
Anti-Oxidant Content						
Total Phenolics (mg GAE/g)	19.84±2.34	229.14±46.06	209.3	6.26	2.44	S*
Total Flavonoids (mg QE/g)	2.00±1.27	66.41±15.07	66.41	6.20	2.44	S*
Radical Scavenging Activity (%)	1.06±0.45	36.58±5.60	35.52	9.75	2.44	S*

S*=Significant, Ns**=Non-Significant, S.A*=Statistical Analysis (P<0.05)

The above table no: 2 shows that **Moisture** content of control “Muffins” was 28.85 percent and it was gradually decreased in best treatment (T₂) 17.97 percent due to incorporation of Flax Seed Flour and Black Rice Flour which has lower Moisture absorption capacity due to its high fibre lignans present in Flax Seed Flour which inhibit the moisture availability in “Muffins”. **Chung et.,al (2014)** reported that a higher fibre content in the biscuit formula prepared from

modified sticky rice flour absorbed more moisture; as a result, the biscuit mix has less water left in the formulation, which results in a lower spread ratio.

Ash content of control “*Muffins*” was 2.14 gm and it was gradually increased in best treatment (T₂) 4.46 gm due to ash was found higher in the best treatment (T₂), due to its high fibre present in both Flax Seed Flour and Black Rice Flour in “*Muffins*”. **Raghuvanshi et.,al (2019)** reported that the ash content in muffins prepared by utilizing roasted flax seed flour ranged from 0.81 % to 1.37% respectively.

Protein content of control “*Muffins*” was 3.21 gm and it was gradually increased in best treatment (T₂) 12.84 gm due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of essential amino acids. **Mohamed et al., (2020)** reported that flaxseed protein has a variety of beneficial characteristics, including solubility, emulsion capacity, water/oil adsorption ability, and foaming capacity. These qualities are significantly influenced by a variety of parameters, including as temperature, ionic strength, and pH.

Fat content of control “*Muffins*” 10.68 gm and it was gradually increased in best treatment (T₂) 11.17 gm due to incorporation of Black Rice Flour Flax Seed Flour which are the richest source of polyunsaturated fatty acids and alpha linolenic acids. **Pathak et., al (2010)** reported that a diet that includes black rice may also aid to enhance cardiovascular measures by lowering triglycerides and raising HDL levels. The most common cause of heart attacks, atherosclerotic plaques, can be prevented in their tracks by anthocyanins. Anthocyanins are essential for lowering triglycerides. Black rice contributes to an increase in high-density lipoprotein (HDL) cholesterol. A healthy cardiovascular system requires this kind of "good" cholesterol to operate correctly. The research revealed that black rice also lessens artery stiffening, which can result in heart failure. Dietary fibre is abundant in black rice. The prevention of heart disease, high blood pressure, stroke, elevated blood sugar levels and other diseases has also been related to dietary fibre.

Crude Fibre of control “*Muffins*” 1.13 gm and it was gradually increased in best treatment (T₂) 4.87 gm due to incorporation of Black Rice Flour and Flax Seed Flour, which is the richest source of both soluble and insoluble fibre. **Yun et.,al (2008)** reported that crude fibre provides the stool bulk so that it may easily move through to the colon and depart from the body.

Additionally, as hazardous substances combine with tissue in the colon, they are eliminated from the body as stool.

Carbohydrate of control “Muffins” 56.33 gm and it was gradually decreased in best treatment (T₂) 49.97 gm due to incorporation of Black Rice Flour and Flax Seed Flour which are the lower source of Carbohydrates. **Hutchins *et.,al* (2013)** who reported that in patients with type 2 diabetes and in those with prediabetes flaxseed supplementation, decreased blood glucose levels because flax seeds carbohydrate content is lower.

Energy of control “Muffins” 346.68 kcal and it was gradually increased in best treatment (T₂) 400.47 kcal due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Energy. **Turturică *et.,al* (2018)** who reported that the energy content of the black rice incorporated muffins were 1658.24kcal.

Iron of control “Muffins” 1.82 mg and it was gradually increased in best treatment (T₂) 2.82 mg due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Iron. **Verma *et.,al* (2017)** who reported that the growth, development, and efficient maintenance of the human body based on minerals like Iron.

Calcium of control “Muffins” 21.47 mg and it was gradually increased in best treatment (T₂) 65.43 mg due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Calcium. **Waghmare *et., al* (2018)** reported that the flax seed can be used in baked goods in a variety of forms, including whole, milled, ground, roasted, and oil. which enhanced the calcium content ranged 255mg/100gm of the muffins.

Zinc of control “Muffins” 0.78 mg and it was gradually increased in best treatment (T₂) 1.65 mg due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Zinc. **Prasad *et., al* (2018)** who reported that muffins incorporated with flax seed flour which enhanced 4.34mg/100gm of zinc.

Phosphorous of control “Muffins” 68.23 mg and it was gradually increased in best treatment (T₂) 166.08 mg due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Phosphorous. **Yogesh *et.,al* (2018)** who reported that muffins incorporated with flax seed flour which enhanced 642mg/100gm of phosphorous.

Potassium of control “Muffins” 74.14 mg and it was gradually increased in best treatment (T₂) 245.28 mg due to incorporation of Black Rice Flour and Flax Seed Flour which are the richest source of Potassium. **Saxena et., al (2012)** who reported that muffins incorporated with flax seed flour which enhanced 831mg/100gm of potassium.

Oxalate content of control “Muffins” 0.07 mg and it was gradually increased in best treatment (T₂) 0.17mg due to incorporation of Black Rice Flour and Flax Seed Flour, Daily intake of Oxalate below the range of 60 mg/day is safe limit for consumption and do not cause any side effects. **Oranye et.,al (2006)** reported that antinutrients like oxalates and tannin are substances that plants have developed over time for a variety of biological purposes, including self-defense. They inhibit the maximal use of micronutrients, particularly proteins, vitamins, and minerals, lowering the nutritional content of the food. Inappropriate consumption of certain of these plant compounds has been found to be harmful to health or to clearly benefit both both human and animal health.

Tannin content of control “Muffins” 0.70 mg and it was gradually increased in best treatment (T₂) 1.52 mg due to incorporation of Black Rice Flour and Flax Seed Flour. **Negussie et.,al (2014)** reported that tannins are heat resistant, and they reduced the bioavailability of protein in both both animals and humans. This was likely due to tannins rendering protein partially inaccessible or by blocking digestive enzymes and raising faecal nitrogen. Tannins, which are known to be found in food stuffs, are known to reduce the protein content of foods, block their actions of trypsin, chemotrypsin, amylase, and lipase, as well as to obstruct the absorption of nutritional iron.

Phytate content of control “Muffins” 0.44 mg and it was gradually increased in best treatment (T₂) 0.74 mg due to incorporation of Black Rice Flour and Flax Seed Flour. **Kumar et.,al (2018)** reported that the phytic acid level of flaxseed meal is 2.3-3.3%, resulting in reduced nutritional absorption. The amount of hydrogen cyanide generated by flaxseed is negligible and far less than the deadly or lethal quantity. The amount of hydrogen cyanide released by 1-2 teaspoons is around 5-10 mg (recommended daily intake of flaxseed). This is far less than the acute hazardous dosage, which is believed to be 50-60 mg. Furthermore, humans can detoxify cyanide levels as low as 30-100 mg/day.

Total Phenolics content of control “Muffins” 19.84 mg and it was gradually increased in best treatment (T₂) 229.14 mg due to incorporation of Black Rice Flour which is rich in Anthocyanin pigment in a form of antioxidant. **Claudia et., al (2018)** who reported that the total phenolic content of black rice incorporated muffins found 226.5 mg GA/100 g.

Total Flavonoid content of control “Muffins” 2.00 mg and it was gradually increased in best treatment (T₂) 66.41 mg due to incorporation of both Black Rice Flour and Flax Seed Flour, which has higher percent of Anthocyanin pigment and P-coumaric acid in a form of Flavonoids. **Nicoleta Stănciuc et., al (2018)** who reported that the total flavonoid content of black rice incorporated muffins found 187.1 QE/100g.

Radical Scavenging Activity (DPPH)% of control “Muffins” 1.06 percent and it was gradually increased in best treatment (T₂) 36.58 percent due to incorporation of Black Rice Flour and Flax Seed Flour which has higher percent of Anthocyanin pigment and P-coumaric acid. **Pal et.,al (2018)** who reported that anthocyanin, in a form of DPPH substance found in black rice, is the one that scavenges undesirable molecules, aids in artery protection, and reduces the risk of DNA damage.

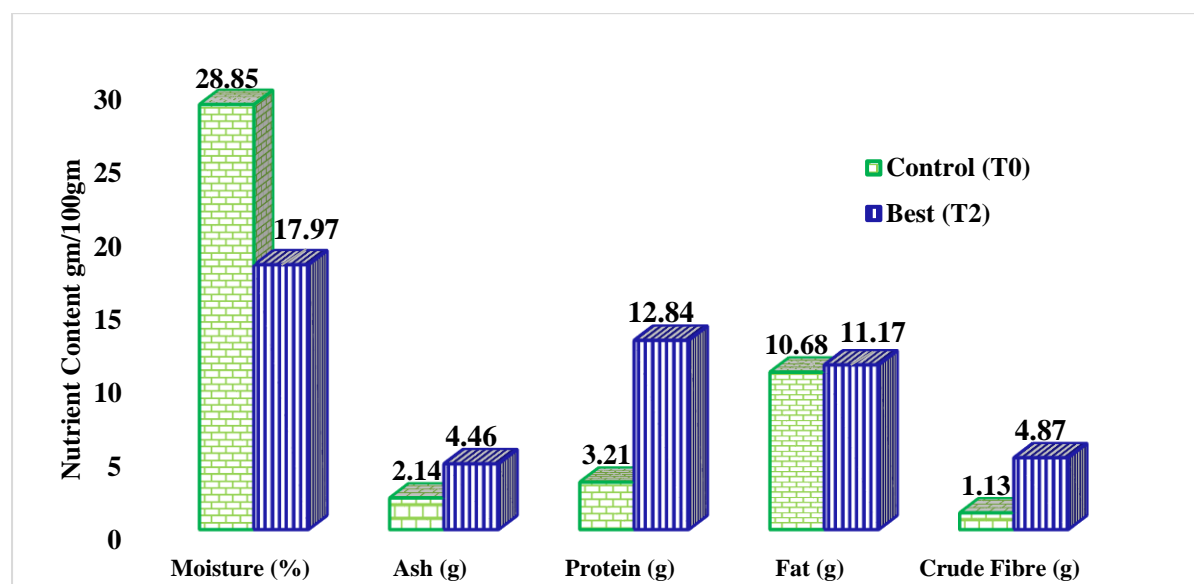


Figure no: 3 Proximate Composition of Control and Best treatment of “Muffins”

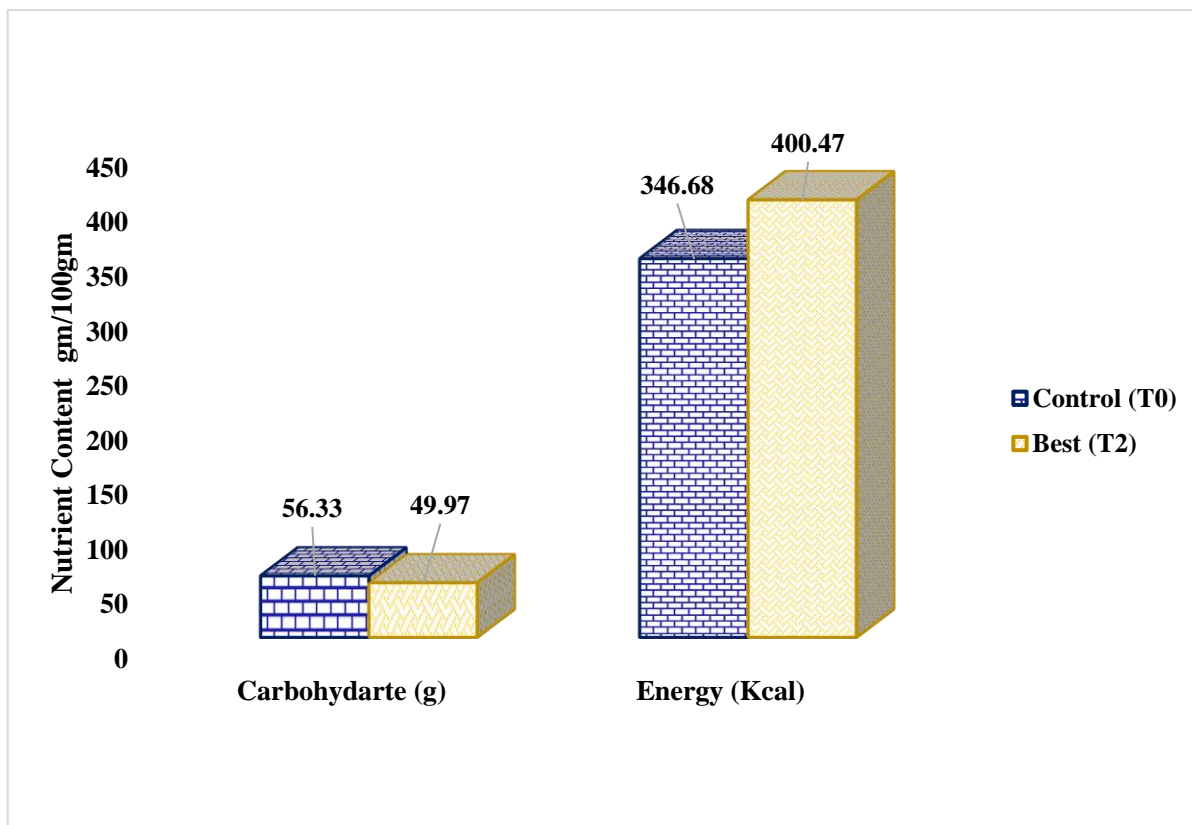


Figure no: 4 Proximate Composition of Control and Best treatment of “Muffins”

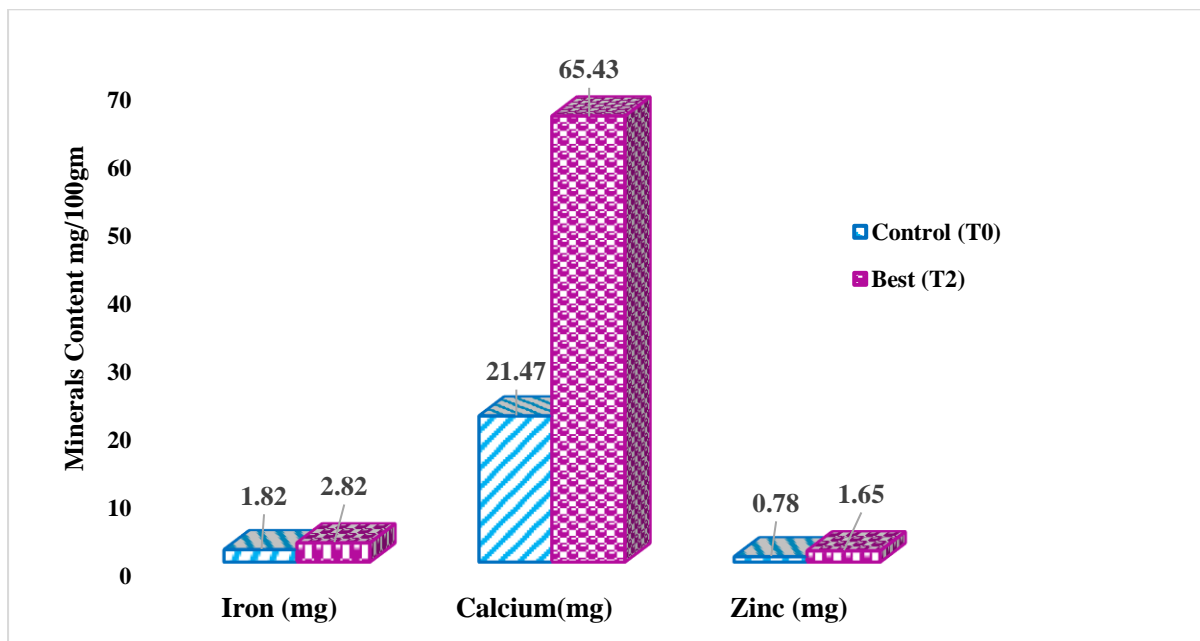


Figure no:5 Mineral Content of Control and Best treatment of “Muffins”

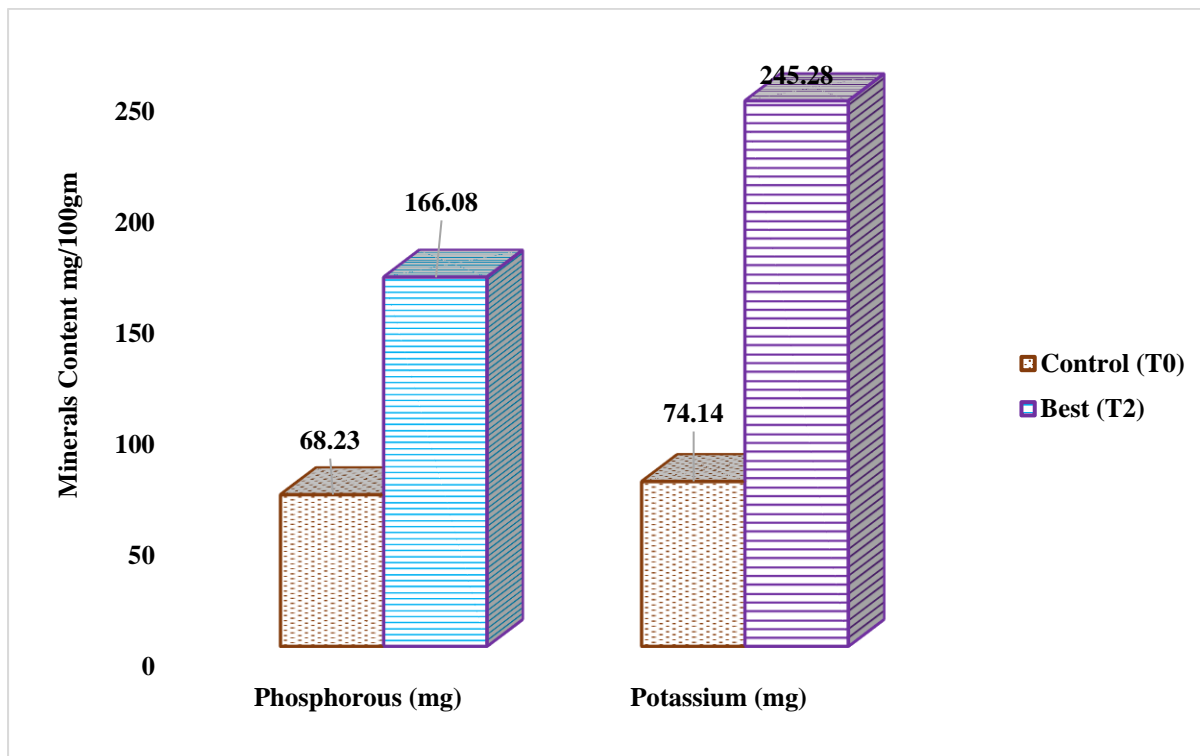


Figure no: 6 Mineral Content of Control and Best treatment of “Muffins”

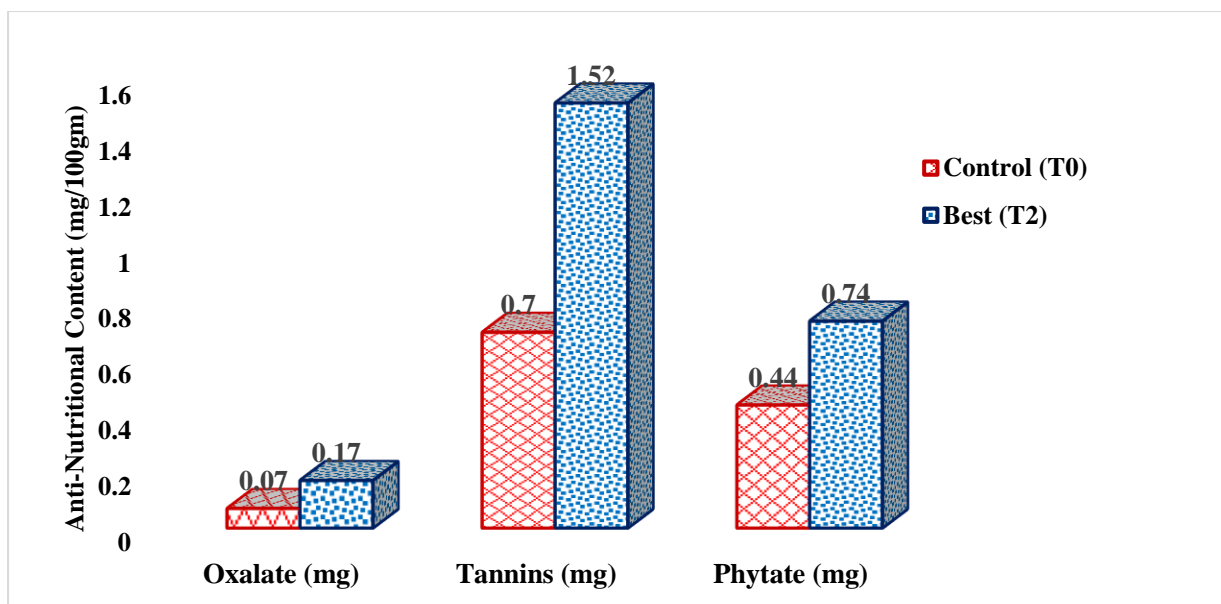


Figure no:7 Anti-Nutritional Content of Control and Best treatment of “Muffins”

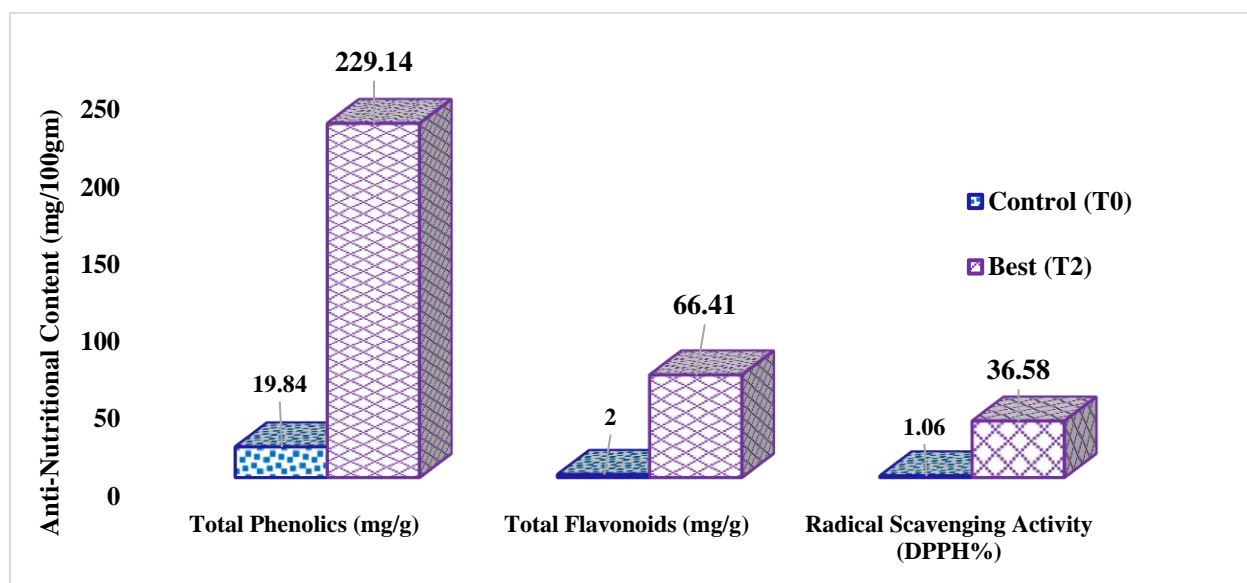


Figure no: 8 Anti-oxidant Content of Control and Best treatment of “Muffins”

Comparative analysis of Storage Period of Total Plate Count, Yeast and Mould and Coliform Count of Control (T₀) with Best treatment (T₂) of “Muffins” by using “t- test”.

It was observed that **Total Plate Count** in “Muffins” control at Day 7 i.e., 2.57×10^2 , Day 14 count i.e., 5.11×10^5 , Day 21 count i.e., 6.17×10^5 , whereas in best treatment Total Plate Count increased which was observed at day 7 onwards of storage period. Day 7 count i.e., 3.78×10^2 , Day 14 count i.e., 6.52×10^5 , Day 21 count i.e., 7.92×10^5 . It indicates the control was lesser total plate count than the best treatment of “Muffins”.

It was observed that that **Yeast and Mould count** in control at Day 7 count i.e., 0.52×10^2 , Day 14 count i.e., 2.32×10^4 and Day 21 count i.e., 3.22×10^4 , whereas in Best treatment Yeast and Mould increased which was observed at day 7 onwards of storage period. Day 7 count i.e., 0.68×10^2 , Day 15 count i.e., 2.79×10^4 and Day 21 count i.e., 4.18×10^4 . It indicates the control was lesser yeast and mould count than the best treatment of “Muffins”.

It was observed that **Coliform count** in control at Day 14 count i.e., 0.32×10^2 , Day 21 Count i.e., 0.86×10^2 , whereas in best treatment coliform increased at day 21 onwards of storage period. Day 14 count i.e., 0.58×10^2 , Day 21 count i.e., 0.92×10^2 . It indicates the control was lesser coliform count than the best treatment of “Muffins”.

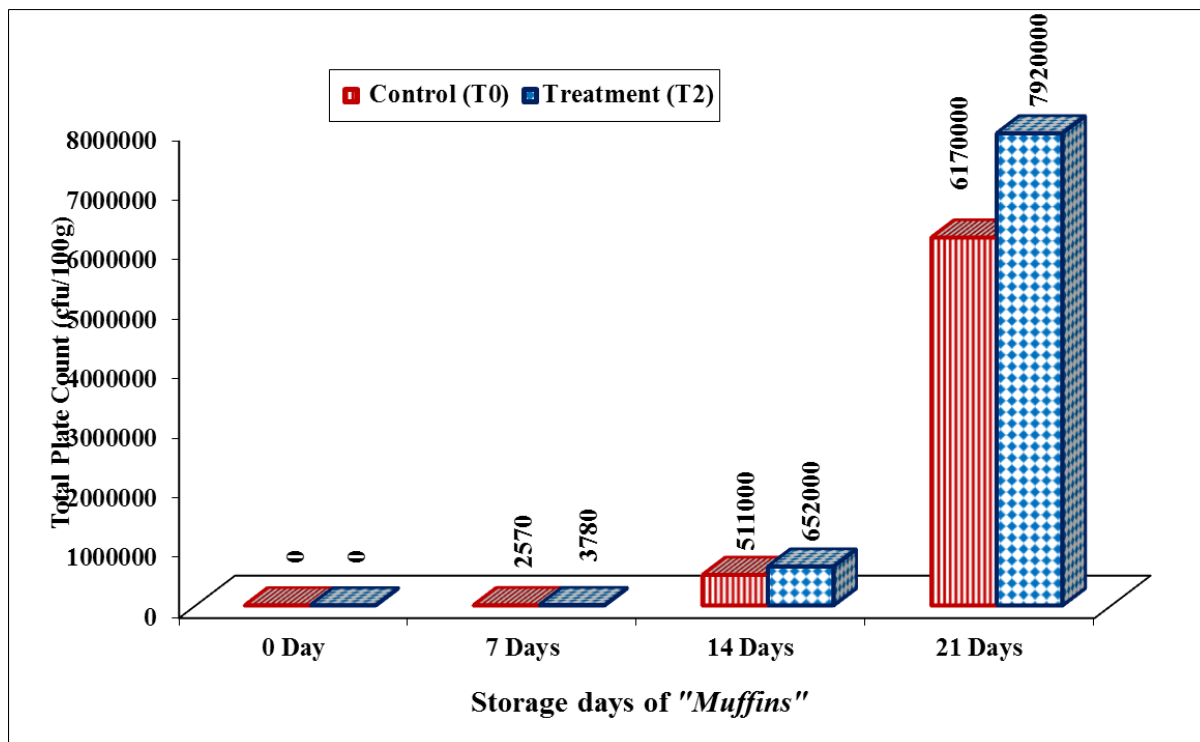


Figure no: 9 Total Plate Count of Control and Best Treatment of "Muffins"

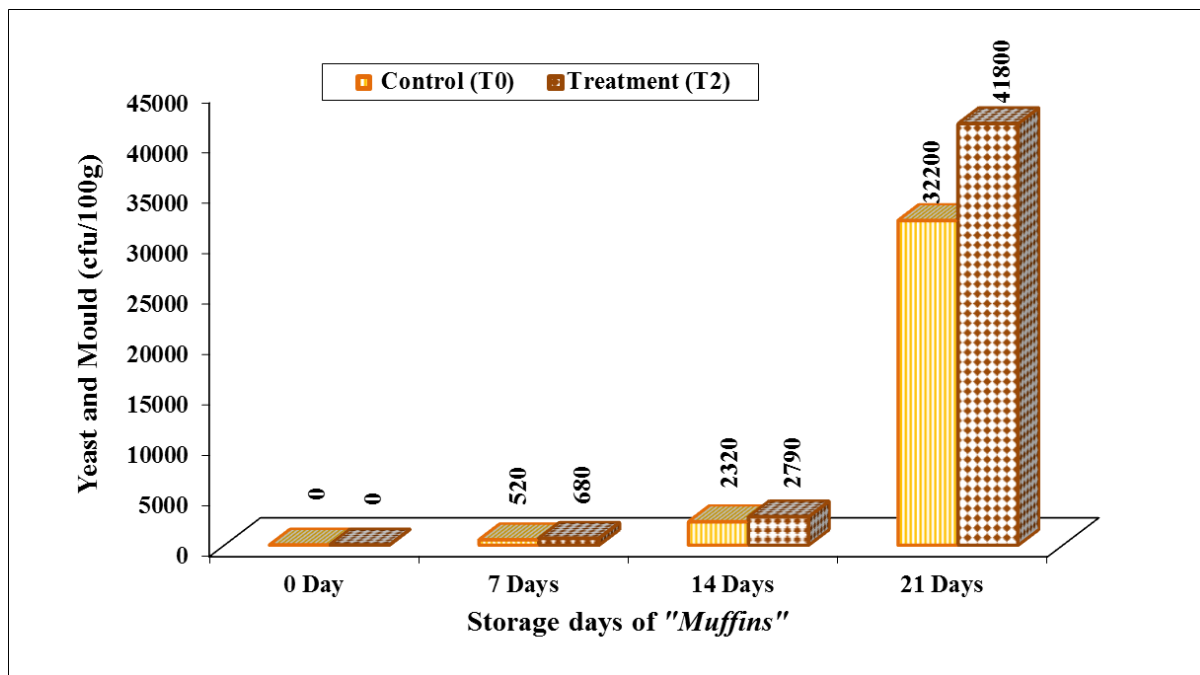


Figure no: 10 Yeast and Mould Count of Control and Best Treatment of "Muffins"

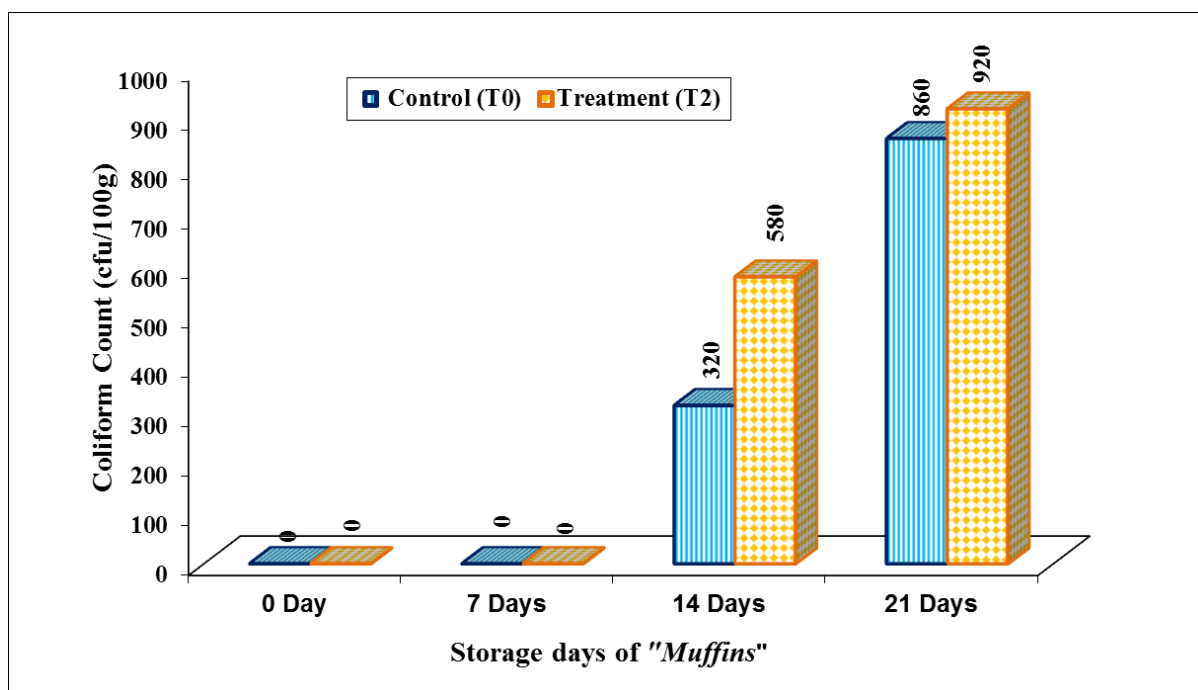


Figure no:11 Coliform Count of Control and Best Treatments of "Muffins"

Table no: 3 Cost of the prepared value-added food product namely "Muffins"/100gm.

Ingredients	Actual Rate/Kg (Rs)	T ₀		T ₁		T ₂		T ₃	
		Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)
Refined Flour	30	100	3	25	0.75	30	0.9	35	1.05
Black Rice Flour	170	-	-	45	7.65	50	8.5	55	9.35
Flax Seed Flour	115	-	-	30	3.45	20	2.3	10	1.15
Butter	480	30	14.4	30	14.4	30	14.4	30	14.4
Sugar	30	30	0.9	30	0.9	30	0.9	30	0.9
Salt	22	1	0.02	1	0.02	1	0.02	1	0.02
Baking Powder	65	1	0.06	1	0.06	1	0.06	1	0.06
Baking Soda	276	1	0.27	1	0.27	1	0.27	1	0.27
Vanilla Essence	50/50ml	5ml	0.25	5ml	0.25	5ml	0.25	5ml	0.25
Total Amount (Rs.)			18.9		27.75		27.6		27.45

Table no: 3 Shows that the cost of the raw materials of “Muffins” was T_0 is Rs.18.9, T_1 is 27.75, T_2 is 27.6 and T_3 is 27.45 It was therefore concluded that the T_1 has the highest cost and T_0 , T_2 , T_3 has the lowest cost because the incorporation level of Black Rice Flour and Flax Seed Flour, which decreased the cost of prepared products marginally.

CONCLUSION

Among all the experimented treatments T_2 had been highly scored (9) by the Sensory panel of judges on the basis of organoleptic properties followed by T_0 , T_1 , and T_3 respectively. The ratio of most acceptable treatments T_2 was 30 percent Refined Flour+50percent Black Rice Flour+20 percent Flax Seed Flour. By incorporation of Black Rice Flour and Flax Seeds Flour is to increase the bio availability of nutrients in value added food Products “Muffins” and the access microbial load i.e., Total Plate Count, Yeast and Mould and Coliform Count at different interval of time in the value added “Muffins” was found to be acceptable up to day 7 at room temperature. By incorporation of Black Rice Flour and Flax Seeds Flour in bakery goods is to increase the availability of nutrients in value added “Muffins”, which was found rich in soluble and insoluble fibre, Vitamin E, Omega 3 and 6 fatty acids, Calcium, Iron, Zinc, Potassium, Phosphorous, Protein, Fat, Carbohydrate, Energy and Antioxidant which helps in to reduce the risk of some types of cancer, heart disease, and Alzheimer’s disease and also helped to decrease the risk of metabolic syndrome.

REFERENCES:

- **María Micaela Ureta & Daniela F. Olivera & Viviana O. Salvadori (2014)** Quality Attributes of Muffins: Effect of Baking Operative Conditions *Journal of Food Bioprocess Technology* (Springer) 7:463–470: DOI 10.1007/s11947-012-1047-7.
- **Parvinder Kaur¹, Roji Waghmare², Vikas Kumar¹, Prasad Rasane¹, Sawinder Kaur¹ and Yogesh Ga (2018)** Recent advances in utilization of flaxseed as potential source for value addition *journal of oil seeds and fats crop and lipids (Ocl)*. (2018) **Volume 25**, Number 3, May-June 2018. <https://doi.org/10.1051/ocl/2018018>.

- **Chutipajit S., Cha-um S. and sompornapailin K (2011)** “High contents of proline and anthocyanin increase protective response to salinity in *Oryza sativa* I.” spp, Indica. *Aust. J. Crop Sci.*, 5: 1191-1198.
- **Gacula Jr, Singh. (2008)** Impact of indigenous fibre rich premix supplementation on blood glucose levels in diabetics. *American Journal Food Technology.*, 3(1): 50-55.
- **Ganorkar, P.M. and Jain, R.K. (2013)** “Flax seed a nutritional punch”, *International Food Research Journal*, 20 (2):519-525.
- **Srilakshmi B. (2007)** Food Science, 4th Ed. New age international (P) Ltd., New Delhi. 170-174.
- **Chandra, S. Singh, and D. Kumari, (2015)** “Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits,” *Journal of Food Science and Technology*, vol. 52, no. 6, pp. 3681–3688, 2015.
- **H. J. Chung, A. Cho, and S. T. Lim, (2014)** “Utilization of germinated and heat-moisture treated brown rices in sugar-snap cookies,” *LWT-Food Science and Technology*, vol. 57, no. 1, pp. 260–266, 2014.
- **V. P. Raghuvanshi, R. S. Agrawal and P. D. Shere (2019)** Nutritional Enhancement of Muffins Incorporated with Flaxseeds 2019 JETIR June 2019, *Journal of Emerging Technologies and Innovative Research (JETIR)* www.jetir.org Volume 6, Issue 6, p.n. 410-416, www.jetir.org (ISSN-2349-5162).
- **Mohamed, R. S., Fouda, K., & Akl, E. M. (2020).** Hepatorenal protective effect of flaxseed protein isolate incorporated in lemon juice against Food Hydrocolloids, 94, 20-29. <http://dx.doi.org/10.1016/j.foodhyd.2019.03.007>.
- **Lobo V, Patil A, Phatak A, Chandra N, (2010)** Free radicals, antioxidants and functional foods: Impact on human health. *Phcog Rev.*2010; 4:118-126.
- **Kim, Jung Yun, et al, (2008)** Meal replacement with mixed rice is more effective than white rice in weight control, while improving antioxidant enzyme activity in obese women. *Nutrition research*, 2008; 28(2), 66- 71.
- **Hutchins, A.M.; Brown, B.D.; Cunnane, S.C.; Domitrovich, S.G.; Adams, E.R.; Bobowiec, C.E. (2013)** Daily flaxseed consumption improves glycemic control in

- obese men and women with pre-diabetes: A randomized study. *Nutr. Res.* 2013, 33, 367–375. [CrossRef].
- **D.K. Verma, P.P. Srivastav (2017)** Proximate composition, mineral content and fatty acids analyses of aromatic and non-aromatic Indian rice *Rice Science*, 24 (2017), pp. 21-31, 10.1016/j.rsci.2016.05.005.
 - **Parvinder Kaur¹ , Roji Waghmare² , Vikas Kumar¹ , Prasad Rasane¹ , Sawinder Kaur¹ and Yogesh Gat¹,*(2018)** Recent advances in utilization of flaxseed as potential source for value addition: *OCL* 2018, 25(3), A304 P. Kaur et al., Published by EDP Sciences, 2018 <https://doi.org/10.1051/ocl/2018018> www.ocl-journal.org.
 - **Parvinder Kaur¹ , Roji Waghmare² , Vikas Kumar¹ , Prasad Rasane¹ , Sawinder Kaur¹ and Yogesh Gat¹,*(2018)** Recent advances in utilization of flaxseed as potential source for value addition: *OCL* 2018, 25(3), A304 P. Kaur et al., Published by EDP Sciences, 2018 <https://doi.org/10.1051/ocl/2018018> www.ocl-journal.org.
 - **Parvinder Kaur¹ , Roji Waghmare² , Vikas Kumar¹ , Prasad Rasane¹ , Sawinder Kaur¹ and Yogesh Gat¹,*(2018)** Recent advances in utilization of flaxseed as potential source for value addition: *OCL* 2018, 25(3), A304 P. Kaur et al., Published by EDP Sciences, 2018 <https://doi.org/10.1051/ocl/2018018> www.ocl-journal.org.
 - **Charu Katare*, Sonali Saxena, Supriya Agrawal, GBKS Prasad and P.S. Bisen(2012)** Flax Seed: A Potential Medicinal Food *Journal of Nutrition & Food Sciences*, Katare et al., *J Nutr Food Sci* 2012, 2:1 DOI: 10.4172/2155-9600.1000120.
 - **Ugwu, F. M. and Oranye, N. A. (2006).** Effects of some processing methods on the toxic components of African breadfruit (*Treculia qfricana*). *African Journal of Biotechnology* 5,2329-2333.
 - **Habtam Fekadu Gemedo, Negussie Ratta. (2014)** Antinutritional Factors in Plant Foods: Potential Health Benefits and Adverse Effects. *International Journal of Nutrition and Food Sciences*. Vol. 3, No. 4, 2014, pp. 284-289. doi: 10.11648/j.ijnfs.20140304.18.

- **Parvinder Kaur¹ , Roji Waghmare² , Vikas Kumar¹ , Prasad Rasane¹ , Sawinder Kaur¹ and Yogesh Gat^{1,*} (2018)** Recent advances in utilization of flaxseed as potential source for value addition, *journal of Oilseeds & fats Crops and Lipids*, OCL 2018, 25(3), A304, www.ocl-journal.org. <https://doi.org/10.1051/ocl/2018018.P.N> 1-12.
- **Constantin Croitoru ¹ , Claudia Mures, an ² , Mihaela Turturică ³ , Nicoleta Stănciuc ³ , Doina Georgeta Andronoiu ³ , Loredana Dumitras, cu ³ , Vasilica Barbu ³ , Elena Enachi (Ionit,ă) ³ , Georgiana Horincar (Parfene) ³ and Gabriela Râpeanu ^{3,*} (2018)** Improvement of Quality Properties and Shelf Life Stability of New Formulated Muffins Based on Black Rice. *Molecules* 2018, 23, 3047; doi:10.3390/molecules23113047, www.mdpi.com/journal/molecules.
- **Constantin Croitoru ¹ , Claudia Mures, an ² , Mihaela Turturică ³ , Nicoleta Stănciuc ³ , Doina Georgeta Andronoiu ³ , Loredana Dumitras, cu ³ , Vasilica Barbu ³ , Elena Enachi (Ionit,ă) ³ , Georgiana Horincar (Parfene) ³ and Gabriela Râpeanu ^{3,*} (2018)** Improvement of Quality Properties and Shelf Life Stability of New Formulated Muffins Based on Black Rice. *Molecules* 2018, 23, 3047; doi:10.3390/molecules23113047, www.mdpi.com/journal/molecules.
- **Imana Pal, Ars Artium (2018):** An International Peer Reviewed-cum-Refereed Research Journal of Humanities and Social Sciences ISSN (Online) : 2395-2423 • ISSN (Print) : 2319-7889 Vol. 6, January 2018 Pp. 126-132 <http://www.arsartium.org>.